ALBERTANS & CLIMATE CHANGE

Taking ACTION

SPECIFIED GAS REPORTING: ALBERTA'S 2004 INDUSTRIAL GREENHOUSE GAS EMISSIONS

Alberta
ENVIRONMENT

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Any comments, questions, or suggestions regarding the content of this document may be directed to:

Evaluation and Reporting Section
Environmental Monitoring and Evaluation Branch
Environmental Assurance
Alberta Environment
10th floor, Oxbridge Place
9820 - 106th Street
Edmonton, AB
T5K 2J6
Phone: (780) 427-0685
Fax: (780) 422-8606

Additional copies of this document may be obtained by contacting:

Alberta Environment Information Centre
Main Floor, 9820 - 106 Street
Edmonton, Alberta T5K 2L6
Phone: (780) 427-2700 (Toll free by first dialing 310-000)
Fax: (780) 422-4086
E-mail: env.infocent@gov.ab.ca

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Executive summary

The specified gas reporting program was developed as part of the Government of Alberta's climate change action plan, *Albertans and Climate Change: Taking Action*, released in October 2002. The *Climate Change and Emissions Management Act* defines a specified gas as any gas that traps heat near the earth's surface. Specified gases include the following greenhouse gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. For the purpose of clarity specified gases will be referred to as greenhouse gases in this report.

Reporting of greenhouse gas emissions from large industrial sources is a fundamental component of Alberta's action plan to address climate change. An accurate accounting of these emissions is needed to assist both the province and industry in characterizing emission sources and identifying opportunities for, and reporting progress on, reductions in greenhouse gas emissions.

In the first reporting year, large industrial facilities that emitted a minimum of 100 kilotonnes of greenhouse gases, expressed as carbon dioxide equivalents, were required to report their 2003 emissions directly to Alberta Environment. For the second reporting year, these facilities were required to report their 2004 emissions to Alberta Environment through the national Electronic Data Reporting system administered by Statistics Canada.

The data used in this report is current as of December 6, 2005. The deadline for reporting 2004 greenhouse gas emissions was June 1, 2005. Alberta facilities reported in accordance with the *Specified Gas Reporting Regulation* and the accompanying *Specified Gas Reporting Standard*. This report provides the results of the second year of reporting of greenhouse gas emissions from large industrial facilities in Alberta.

Results of reporting in 2004

In 2004, 99 large industrial facilities in Alberta reported a total of 110 megatonnes of greenhouse gas emissions, expressed as carbon dioxide equivalents. The key results of the mandatory specified gas reporting program for 2004 are outlined below.

1. Large industrial emitters of greenhouse gases in Alberta represented 47 per cent of total greenhouse gas emissions in Alberta and 64 per cent of all greenhouse gases emitted by industry in the province. These results are based on comparing the reported emissions for 2004 to the provincial data in the *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2004*.

2. The highest percentages of total greenhouse gas emissions reported from large industrial emitters were from power plants (46 per cent), oil sands facilities (18 per cent) and gas plants (8 per cent).

3. The majority of greenhouse gases emitted from large industrial facilities were in the form of carbon dioxide (96 per cent) and were from stationary combustion sources (85 per cent). The remaining four per cent were distributed between methane, nitrous oxide and hydrofluorocarbons. No Alberta facilities reported perfluorocarbons or sulphur hexafluoride for 2004.

4. There were 83 facilities that submitted specified gas reports in both the 2003 and 2004 reporting years. The net change in reported greenhouse gas emissions for these facilities was an increase of about four megatonnes. A portion of this net change may be due to refinements in greenhouse gas calculation methods rather than just an absolute increase in greenhouse gas emissions from large industrial facilities.

5. Nationally, Alberta's 2004 reported greenhouse gas emissions were the largest of any other province in Canada, based on reported provincial emissions published in the *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2004*. Alberta represented 39 per cent of total 2004 emissions from facilities emitting more than 100 kt CO_2-e of greenhouse gases. This is the result of Alberta's high number of large industrial facilities from the energy sector (with much of the production being exported) exceeding the reporting threshold and the predominant use of coal for electricity generation in the province.

Continuous improvement

Accurate accounting of greenhouse gas emissions is needed to monitor progress towards meeting facility specific emission targets that are being established in Alberta's proposed *Specified Gas Emitters Regulation*. Alberta Environment is working constructively with Environment Canada, other provinces and territories, industry and environmental associations to improve the specified gas reporting program. Ongoing improvements will:

- Establish standard emissions calculation methods for industrial sectors.
- Develop an audit system so that the government can assure the quality of the data submitted.
- Implement systems to allow electronic submission of Statements of Certification and confidentiality requests.
- Coordinate the process for assessing data and information confidentiality between Alberta Environment and Environment Canada.
- Determine intensity metrics and require the reporting of emissions intensity on a carbon dioxide equivalent basis.

Changes to requirements for the reporting of 2005 greenhouse gas emissions are reflected in the updated *Specified Gas Reporting Standard - March 2006*. The deadline for submitting 2005 greenhouse gas emissions for facilities exceeding the 100 kilotonne threshold is June 1, 2006.

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Abbreviations

AENV:	Alberta Environment
CEMS:	Continuous Emissions Monitoring Systems
CH_4:	methane
CO_2:	carbon dioxide
CO_2-e:	carbon dioxide equivalent
EDR:	Electronic Data Reporting System
EPEA:	Environmental Protection and Enhancement Act
GDP:	Gross Domestic Product
HFCs:	hydrofluorocarbon species including CHF_3, CH_2F_2, CH_3F, $C_5H_2F_{10}$, C_2HF_5, $C_2H_2F_4$, $C_2H_2F_4$, $C_2H_3F_3$, $C_2H_3F_3$, $C_2H_4F_2$, C_3HF_7, $C_3H_2F_6$, $C_3H_3F_5$
IPCC:	Intergovernmental Panel on Climate Change
kt:	kilotonne
Mt:	megatonne
N_2O:	nitrous oxide
NAICS :	North American Industry Classification System
NPRI :	National Pollutant Release Inventory
NSCR :	National Steering Committee on Reporting
PFCs:	perfluorocarbon species including CF_4, C_2F_6, C_3F_8, C_4F_{10}, c-C_4F_8, C_5F_{12}, and C_6F_{14}
SACR :	Stakeholder Advisory Committee on Reporting
SF_6:	sulphur hexafluoride
UNFCCC:	United Nations Framework Convention on Climate Change

1.0 Alberta's plan to address climate change

The Alberta government is committed to reducing greenhouse gas emissions and developing an effective approach to responding to the potential risks of climate change. Alberta's plans are outlined in *Albertans & Climate Change: Taking Action*[i]. The plan provides a comprehensive framework to reduce greenhouse gas emissions while maintaining a prosperous economy over the long term. By 2020, Alberta will cut greenhouse gas emissions in the province relative to our gross domestic product (GDP) by 50 per cent of 1990 levels. This should be approximately a 60 Megatonne (Mt) reduction in greenhouse gas emissions below expected levels. By 2010, it is estimated that Alberta will have achieved an emissions intensity improvement of roughly 20 Mt below expected levels.

Improvements in emissions intensities will require not only reductions in greenhouse gas emissions but also an associated improvement in efficiency of facility operations. The Alberta government is working with industry to encourage the use of best practices and best-in-class technologies. Alberta will back up intensity reduction targets with legislative, regulatory and financial provisions to make it clear what is expected of industry.

1.1 Reporting program

Albertans and Climate Change: Taking Action[i] identifies a provincial specified gas reporting program as an important part of Alberta's action plan to address climate change. Information gathered under the provincial program is needed to assist both the province and industry in characterizing emission sources and identifying opportunities for emission reductions. The provincial specified gas reporting program will allow the Alberta government to monitor progress of specific Alberta emission reduction strategies, such as setting greenhouse gas emission targets, establishing emission-trading systems, implementing greenhouse gas-reduction technologies for industry and promoting improvements in emissions intensity.

The three important components detailing the legalities and expectations of industrial emitters under the reporting program are the *Specified Gas Reporting Standard*[ii], the *Specified Gas Reporting Regulation*[iii], and the *Climate Change and Emissions Management Act*[iv]. In coordination with the national mandatory reporting program, reporting of greenhouse gases in Alberta is being implemented in phases, with subsequent years possibly involving an increasingly detailed level and scope of reporting.

1.2 First reporting year

In the first year of reporting, the Alberta specified gas reporting program required Alberta facilities emitting 100 kilotonnes (kt) or more of greenhouse gases in carbon dioxide equivalent (CO_2-e) units per year (based on the sum of direct emissions of carbon dioxide, methane and nitrous oxide) to report their greenhouse gas emissions directly to Alberta Environment. Emissions were estimated and reported according to the

November 2004 version of the *Specified Gas Reporting Standard*[iv]. The deadline for reporting 2003 greenhouse gas emissions was November 15, 2004. Information gathered during the first year of reporting is detailed in the report: *Alberta Greenhouse Gas Reporting Program for 2003 – Analysis*[v].

1.3 Second reporting year

For the second reporting year, large emitters in Alberta were required to report their 2004 greenhouse gas emissions using the national Electronic Data Reporting (EDR) system administered by Statistics Canada. The collected data was provided to both Alberta Environment and Environment Canada to satisfy both provincial and federal reporting requirements. Separate Statements of Certification and requests for confidentiality were submitted directly to both Environment Canada and Alberta Environment.

The reporting threshold remained unchanged in the second year of reporting; mandatory for facilities emitting 100 kt or more of greenhouse gases in carbon dioxide equivalent units based on the sum of direct emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Three new greenhouse gases (HFCs, PFCs and SF_6) were added to this total to coordinate with the Environment Canada's reporting requirements. Emissions were estimated and reported according to the March 2005 version of the *Specified Gas Reporting Standard*[iv]. The deadline for reporting 2004 greenhouse gas emissions was June 1, 2005.

The Alberta specified gas reporting program will continue to evolve in future years to further a system that gathers the necessary emissions data for regulatory, industry and public interest. Although not mandatory for the reporting of 2003 or 2004 greenhouse gas emissions, emissions intensity will likely be a reporting requirement at some point in the future. Reporting of emissions intensity (emissions per unit of production) enables the government to manage greenhouse gas emissions using an intensity-based approach that integrates both environmental and economic objectives. These intensities will also help to set reduction targets for facilities.

1.4 Stakeholder involvement

Over the last three years, the Alberta government has worked with federal and provincial stakeholders to develop an efficient and effective specified gas reporting program. More recently, consultations specific to the reporting system have been done mainly through involvement with the Stakeholder Advisory Committee on Reporting (SACR) and the National Steering Committee on Reporting (NSCR).

This approach has resulted in a specified gas reporting program that allows optimum flexibility for reporters, while beginning to collect emissions data that is vital to Alberta's climate change action plan. Consultations with stakeholders will continue in the future to ensure a reporting system that collects the necessary emissions data while understanding the needs of industry.

2.0 Confidentiality

2.1 Overview of process

Under section 5(1) of the *Specified Gas Reporting Regulation*[iii]: "a specified gas report may include a written request by the specified gas reporter that portions of the report be kept confidential, for a period of up to five years, on the basis that the information is commercial, financial, scientific or technical information that would reveal proprietary business, competitive or trade secret information about a specific facility, technology or corporate initiative." While a request is being considered, the information is kept confidential as "prescribed information".

In cases where the request is well founded, the relevant information will not be disclosed for the period prescribed by the Director (of the Monitoring and Evaluation Branch of Alberta Environment). Decisions will be based on the criteria in section 5(2) including: whether disclosure would significantly harm competitive position or interfere with the negotiating position of the specified gas reporter, be expected to result in undue financial loss or gain, and whether the information contained in the report is available from other public sources. The *Climate Change and Emissions Management Act*[iv] does not prohibit the publishing of prescribed information in summarized or statistical form in such a manner that it is not possible to relate the information to a particular facility, technology or corporate initiative (see section 17(3) of the Act).

Section 6(2) of the *Climate Change and Emissions Management Act*[iv], states the Environment Minister may disclose information reported under section 6(1) of the Act to the persons and in the form and manner provided for in the regulations. Section 7 of the *Specified Gas Reporting Regulation*[iii] states further that the information contained in specified gas reports may be published in any form and manner the Director (of the Monitoring and Evaluation Branch of Alberta Environment) considers appropriate. Under section 8 of the Regulation, the Director (of the Monitoring and Evaluation Branch of Alberta Environment) must report to the Information and Privacy Commissioner the number of requests received and number of requests approved for withholding of confidential information.

2.2 Summary of confidentiality requests

Of the 99 facilities reporting 2004 emissions, there were a total of 21 requests for confidentiality. These requests came from eight different companies belonging to the cement/lime, chemicals, gas plants, heavy oil, oil sands and petroleum refining facility types. The requests pertain to data contained in Section III (A, B and C) of the submitted specified gas report. Section III contains the following greenhouse gas emissions information:

> A. Greenhouse Gas Emissions for 2004 – detailed emissions of CO_2, CH_4 and N_2O by emission source category (stationary combustion, industrial process, fugitive, venting and flaring, other and on-site transportation), CO_2 emissions from biomass, and emissions of HFC, PFC and SF_6.

B. Greenhouse Gas Emissions Calculation Methods – the general emission calculation method (monitoring or direct measurement, mass balance, emission factors and/or engineering estimates).

C. Total Greenhouse Gas Emissions – total emissions of CO_2, CH_4, N_2O, HFC, PFC, SF_6, and CO_2 emissions from biomass and total facility emissions.

The reporters either requested to keep the entire Section III (A, B, and C) confidential, only Section III (A) confidential, or only portions of Section III (A) confidential. Of the 21 requests received:

- Seven requests for confidentiality were for Section III (A, B, and C) involving three companies;
- Eight requests for confidentiality were for Section III (A) involving two companies;
- Four requests for confidentiality were for stationary combustion, industrial process, fugitive and other emissions involving one company;
- One request for confidentiality for CO_2, CH_4 and N_2O emissions from stationary combustion, industrial process and other sources and total direct emissions; and
- One request for confidentiality for CO_2, CH_4 and N_2O emissions from stationary combustion and industrial process sources.

Confidentiality was granted for up to five-years based on the rationale provided with the request. Nine facilities were granted some form of data confidentiality. Only one facility was granted confidentiality for part C of Section III. Facilities granted confidentiality included one cement/lime facility, one heavy oil plant, four petroleum refineries and three oil sands facilities (see: Table 1). The remaining 12 facilities were not granted any form of confidentiality.

Table 1: Number of facilities by facility type that were granted confidentiality.

Facility Type	Facilities Reporting	Confidentiality Requests	Confidentiality Requests Granted/Partially Granted
Cement/Lime	3	2	1
Chemicals	10	1	0
Coal-mining	1	0	0
Fertilizer	6	0	0
Forest Products	4	0	0
Gas Plants	36	9	0
Heavy Oil	6	2	1
Landfill	1	0	0
Oil Sands	4	3	3
Petroleum Refining	4	4	4
Pipeline	5	0	0
Power Plant	19	0	0
Total:	*99*	*21*	*9*

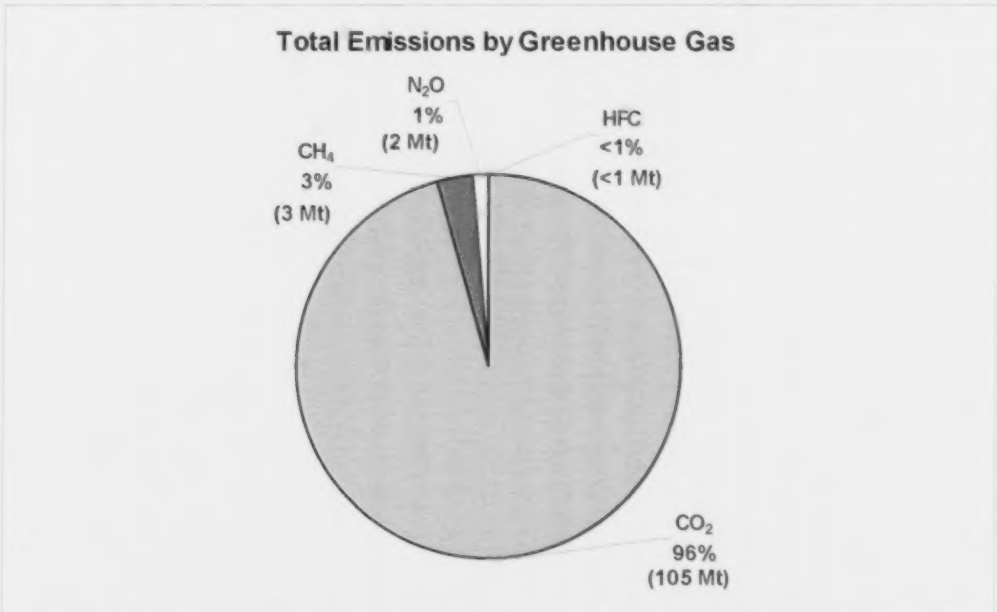
3.0 Statistical review of 2004 data

Total non-confidential 2004 greenhouse gas emissions by facility are provided in Table 4 of the Appendix. All data is presented in units of carbon dioxide equivalents unless otherwise stated.

Quantities expressed in carbon dioxide equivalent (CO_2-e) units are calculated by multiplying the 100-year global warming potential of the individual greenhouse gas by reported emissions for that gas. The global warming potential is the relative measure of the warming effect that the emission of a specific gas might have on the earth's atmosphere as stated in the *Specified Gas Reporting Standard*[4]. The resulting emission numbers for individual gases can then be totaled and expressed as carbon dioxide equivalents.

3.1 Total reported greenhouse gas emissions

In 2004, 99 facilities reported greenhouse gas emissions totaling 110 Mt CO_2-e. The break down of these emissions by greenhouse gas is shown in Figure 1. The majority (96 per cent) of the actual tonnes of reported greenhouse gas emissions were from carbon dioxide. Methane emissions composed three per cent of the total, nitrous oxide one per cent and hydrofluorocarbon less than one per cent. No Alberta facilities reported perfluorocarbon or sulphur hexafluoride emissions.



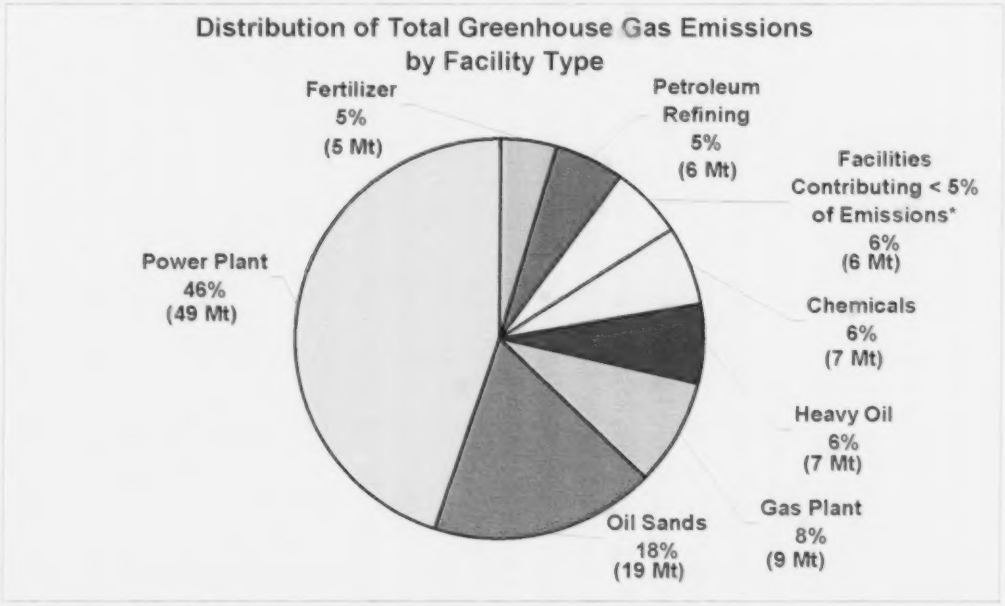
Note: Numbers in this figure are rounded and therefore may differ slightly from those presented elsewhere in this report.
Figure 1: 2004 total reported emissions by greenhouse gas.

3.2 *Emissions by greenhouse gas and facility type*

Large industrial facilities reporting 2004 emissions were classified according to the following facility types: cement/lime, chemicals, coal-mining, fertilizer, forest products, gas plants, heavy oil plants, landfill, oil sands, petroleum refining, pipeline and power plants. The results in this section show emissions in CO_2-e and for each individual greenhouse gas by facility type.

3.2.1 Total emissions by facility type

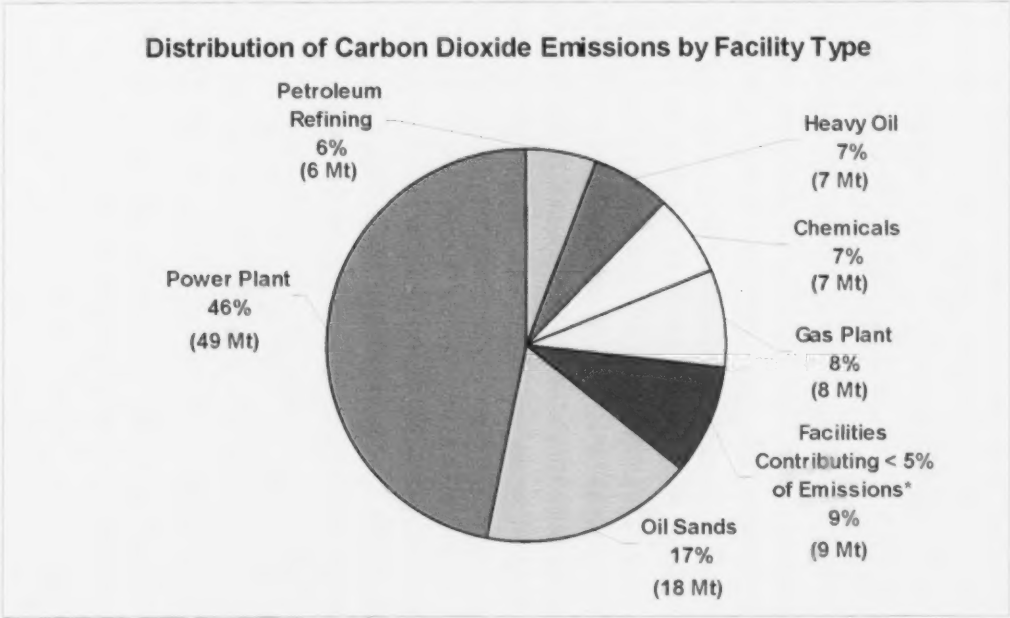
Figure 2 shows the percentages of total greenhouse gas emissions by facility type. Power plants were responsible for the largest portion of total reported greenhouse gas emissions for 2004 with 46 per cent. Oil sands and gas plant facilities were the second and third largest emitters with 18 per cent and eight per cent. Heavy oil, chemicals, petroleum refining and fertilizer facilities each contributed five to nine per cent of total greenhouse gas emissions. The remaining five facility types each contributed less than five per cent of the total emissions.


Distribution of Total Greenhouse Gas Emissions by Facility Type
Fertilizer 5% (5 Mt)
Petroleum Refining 5% (6 Mt)
Facilities Contributing < 5% of Emissions* 6% (6 Mt)
Chemicals 6% (7 Mt)
Heavy Oil 6% (7 Mt)
Gas Plant 8% (9 Mt)
Oil Sands 18% (19 Mt)
Power Plant 46% (49 Mt)

*Facility types included: pipeline, cement/lime, forest products, coal-mining and landfill.
Note: Numbers in this figure are rounded and therefore may differ slightly from those presented elsewhere in this report.
Figure 2: 2004 total greenhouse gas emissions by facility type.

3.2.2 Carbon dioxide emissions by facility type

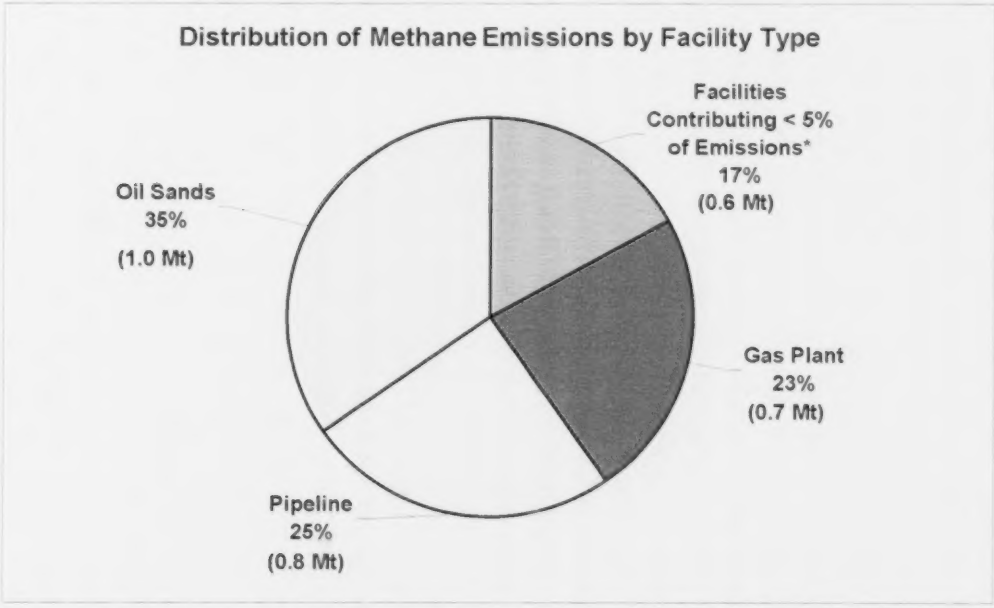
Power plant facilities were the highest contributors of total CO_2 emissions, making up 46 per cent of emissions. Figure 3 gives the percentage contribution of each facility type to total CO_2 emissions. Oil sands facilities were the second largest contributors with 17 per cent and gas plants were third largest with eight per cent. Heavy oil and chemical facilities each contributed seven per cent of CO_2 emissions. Petroleum refineries contributed six per cent of emissions. The remaining facility types each were responsible for less than five per cent of total CO_2 emissions. Cumulatively, these remaining facilities made up nine per cent of CO_2 emissions.


Distribution of Carbon Dioxide Emissions by Facility Type
Petroleum Refining 6% (6 Mt)
Heavy Oil 7% (7 Mt)
Chemicals 7% (7 Mt)
Power Plant 46% (49 Mt)
Gas Plant 8% (8 Mt)
Facilities Contributing < 5% of Emissions* 9% (9 Mt)
Oil Sands 17% (18 Mt)

*Facility types included: landfill, coal-mining, forest products, cement/lime, pipeline and fertilizer.
Note: Numbers in this figure are rounded and therefore may differ slightly from those presented elsewhere in this report.
Figure 3: 2004 CO_2 emissions by facility type.

3.2.3 Methane emissions by facility type

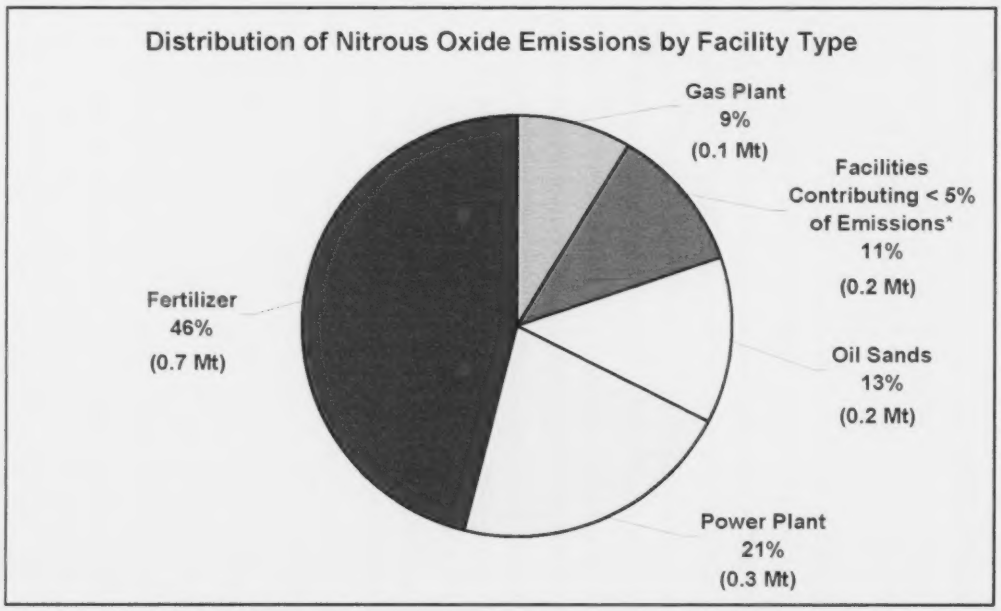
Oil sands facilities accounted for the largest portion of CH_4 emissions with 35 per cent of the total. Figure 4 shows the contribution to total CH_4 emissions by each facility type. Pipeline and gas plant facilities contributed 25 per cent and 23 per cent of CH_4 emissions, respectively. Oil sands, pipeline and gas plant facilities together made up over 80 per cent of all the reported CH_4 emissions. No other facility type contributed more than five per cent of emissions of CH_4. The remaining nine facility types together contributed 17 per cent of CH_4 emissions.


Distribution of Methane Emissions by Facility Type
Facilities Contributing < 5% of Emissions* 17% (0.6 Mt)
Oil Sands 35% (1.0 Mt)
Gas Plant 23% (0.7 Mt)
Pipeline 25% (0.8 Mt)

*Facility types included: cement/lime, chemicals, petroleum refining, power plant, forest products, heavy oil, coal-mining, landfill and fertilizer.
Note: Numbers in this figure are rounded and therefore may differ slightly from those presented elsewhere in this report.
Figure 4: 2004 CH_4 emissions by facility type.

3.2.4 Nitrous oxide emissions by facility type

Nearly half (46 per cent) of all reported 2004 N_2O emissions were from fertilizer plants. Figure 5 shows the contribution of each facility type to total N_2O emissions. Power plant facilities were the second largest contributors with 21 per cent of N_2O emissions. Oil sands and gas plant facilities were the other major N_2O emitters for 2004 contributing 13 per cent and nine per cent of 2004 emissions, respectively. The remaining 11 per cent of N_2O emissions were from other facility types, each contributing less than five per cent of total N_2O emissions.



*Facility types included: landfill, coal-mining, cement/lime, petroleum refining, chemicals, heavy oil, pipeline and forest products.

Note: Numbers in this figure are rounded and therefore may differ slightly from those presented elsewhere in this report.

Figure 5: 2004 N_2O emissions by facility type.

3.2.5 Greenhouse gas contributions to emissions by facility type

For most facility types, CO_2 emissions constituted the majority of reported total greenhouse gas emissions. Figure 6 gives the percentage contribution by each greenhouse gas to total emissions for each facility type. Over 90 per cent of greenhouse gas emissions from cement/lime, chemicals, gas plants, heavy oil, oil sands, petroleum refining and power plant facilities were in the form of CO_2. CH_4 was a major contributor to significant percentages of total greenhouse gas emissions for landfill (100 per cent), coal-mining (69 per cent) and pipeline (24 per cent) facilities. N_2O contributed significant percentages of total greenhouse gas emissions for fertilizer facilities (15 per cent) and forest products facilities (10 per cent). HFCs were only reported by facilities in the chemicals, petroleum refining and power plant facility types, and did not make any significant contributions to greenhouse gas emissions for these facility types.

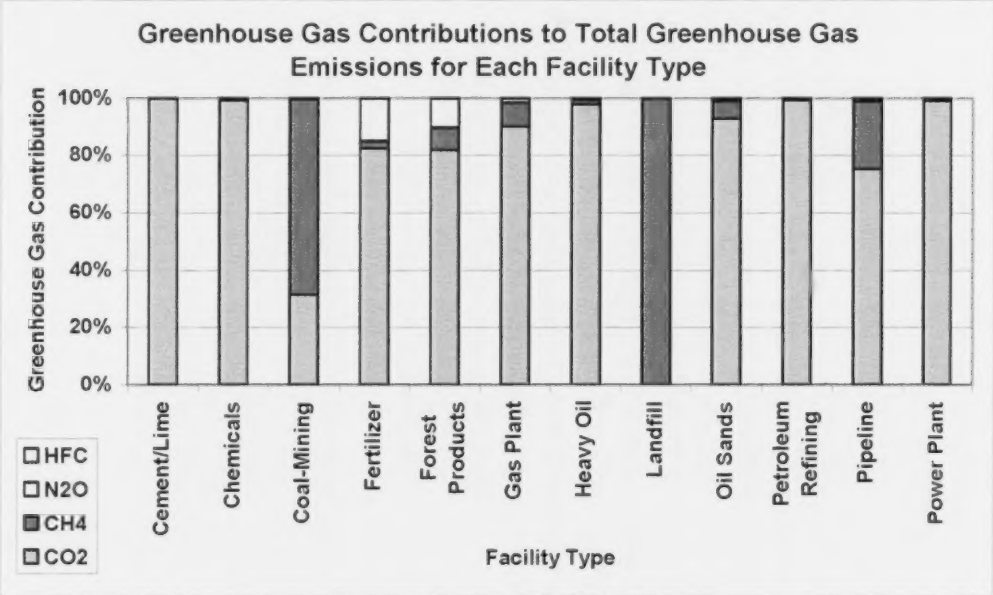


Figure 6: 2004 greenhouse gas emissions by gas for each facility type.

3.3 Emissions by greenhouse gas and source category

The Alberta reporting program (see: section 1) requires reporting of CO_2, CH_4 and N_2O emissions from four source categories: stationary combustion, industrial process, fugitive and other. These sources are defined in the *Specified Gas Reporting Standard*[4] as:

> "Stationary fuel combustion emissions" means direct emissions resulting from non-vehicular combustion of fossil or biomass fuel for the purpose of producing energy but does not include biomass combustion CO_2 emissions.

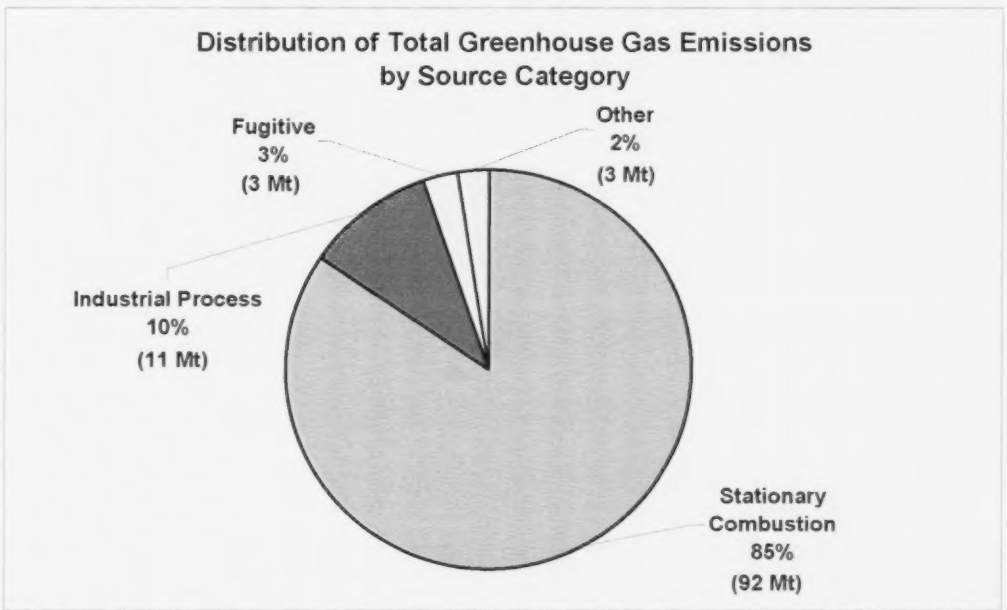
"Industrial process emissions" means direct emissions from an industrial process involving chemical reactions, other than combustion, and where the primary purpose of the industrial process is not energy production.

"Fugitive emissions" means direct emissions that are intentional or unintentional releases of specified gases from industrial activities and includes without limitation emissions from the production, processing, transmission, storage and use of fuels, and include emissions from combustion only when it does not support a productive activity.

"Other emissions" means direct emissions that do not fall under stationary combustion, industrial processes or fugitive emissions, and includes without limitation emissions from on-site disposal of waste and waste or wastewater treatment, and emissions from transportation that are integral to the production process.

3.3.1 Total greenhouse gas emissions by source category

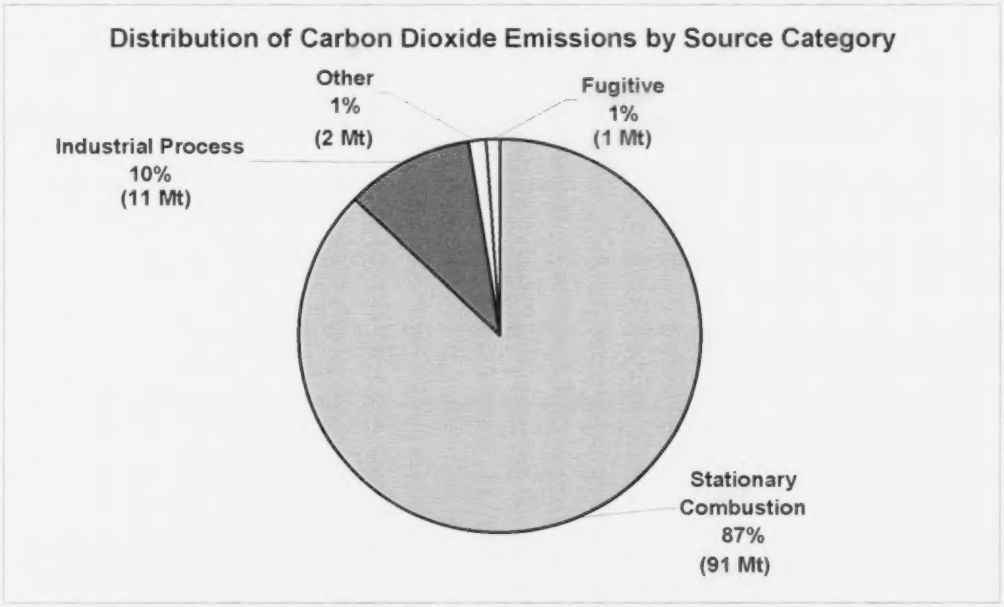
Total reported greenhouse gas emissions were dominated by emissions from stationary combustion sources (85 per cent) for 2004. Figure 7 shows the contribution by emission source types to total greenhouse gas emissions. Emissions from industrial process sources were the second largest contributor with 10 per cent of total greenhouse gas emissions. Fugitive and other sources contributed three per cent and two per cent of emissions, respectively.


Distribution of Total Greenhouse Gas Emissions by Source Category
Fugitive 3% (3 Mt)
Other 2% (3 Mt)
Industrial Process 10% (11 Mt)
Stationary Combustion 85% (92 Mt)

Note: Numbers in this figure are rounded and therefore may differ slightly from those presented elsewhere in this report.
Figure 7: 2004 total greenhouse gas emissions by source category.

3.3.2 Carbon dioxide emissions by source category

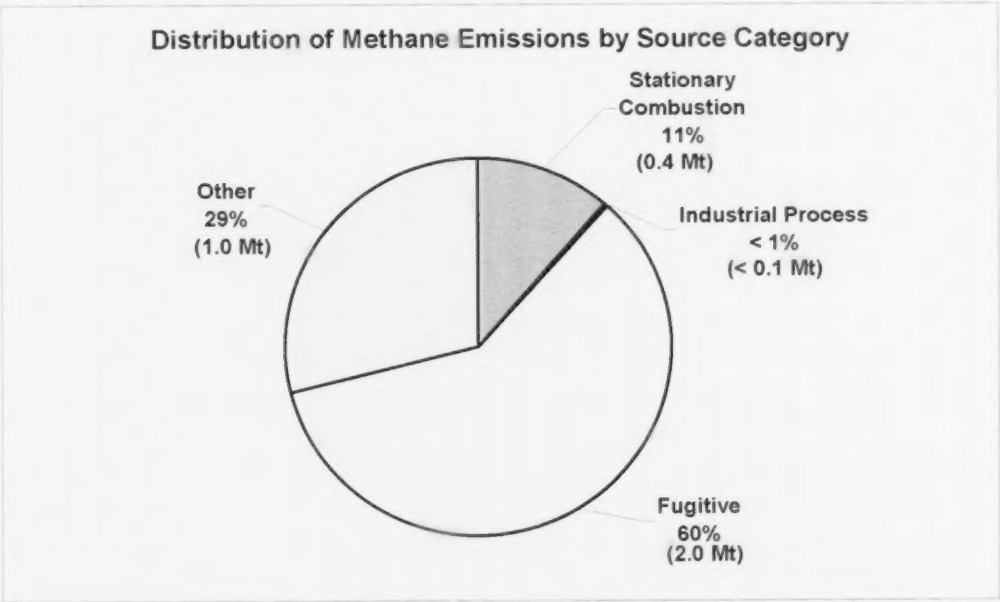
The majority (87 per cent) of CO_2 emissions were from stationary combustion processes. Figure 8 shows the composition by emission source type of total CO_2 emissions. Industrial process sources were the second largest contributor with 10 per cent of total CO_2 emissions. Emissions from other and fugitive sources were each responsible for one per cent of total CO_2 emissions.



Note: Numbers in this figure are rounded and therefore may differ slightly from those presented elsewhere in this report.
Figure 8: 2004 total CO_2 emissions by source category.

3.3.3 Methane emissions by source category

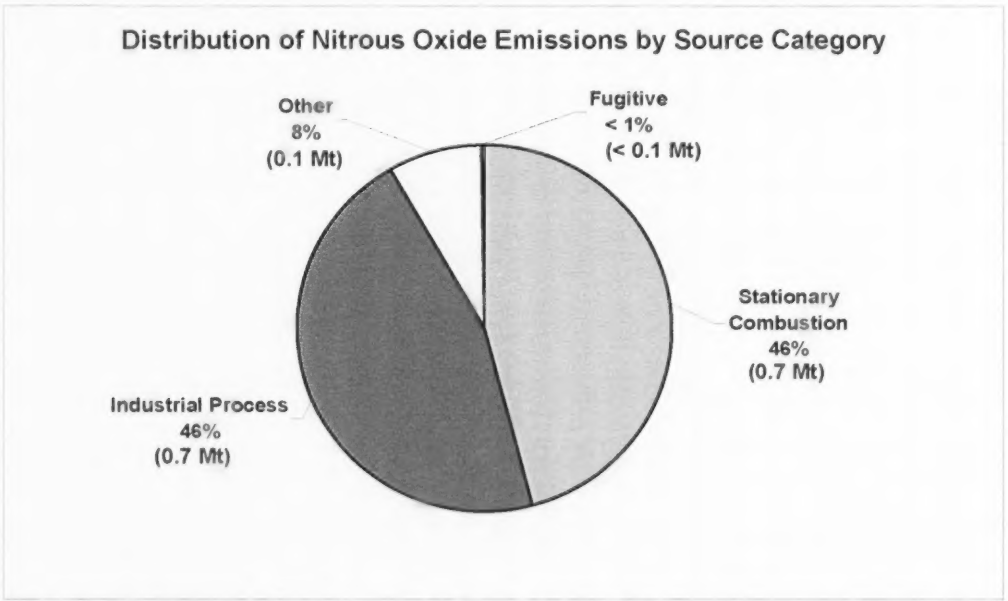
Over half (60 per cent) of total CH_4 emissions were from fugitive sources for 2004. Figure 9 shows the composition by emission source type of total CH_4 emissions. Emissions from other sources were responsible for 29 per cent of emissions, stationary combustion sources 11 per cent of emissions and industrial process sources less than one per cent.


Distribution of Methane Emissions by Source Category
Stationary Combustion 11% (0.4 Mt)
Industrial Process < 1% (< 0.1 Mt)
Fugitive 60% (2.0 Mt)
Other 29% (1.0 Mt)

Note: Numbers in this figure are rounded and therefore may differ slightly from those presented elsewhere in this report.
Figure 9: 2004 total CH_4 emissions by source category.

3.3.4 Nitrous oxide emissions by source category

A total of 92 per cent of reported N_2O emissions for 2004 were from industrial process and stationary combustion sources, each contributing 46 per cent. Figure 10 shows the composition by emission source type of total N_2O emissions. Emissions from other sources were responsible for eight per cent of N_2O emissions, while fugitive sources contributed to less than one per cent of emissions.



Note: Numbers in this figure are rounded and therefore may differ slightly from those presented elsewhere in this report.
Figure 10: 2004 total N_2O emissions by source category.

3.4 HFC, PFC and SF_6 emissions

Six facilities reported emissions of HFCs for 2004. These emissions totaled just five kilotonnes. There were two chemical facilities, two petroleum facilities and two power plants that reported HFCs. The HFCs that were reported were HFC-23, HFC-125, HFC-134a and HFC-143a. Only two facilities are listed in the appendix as having HFC emissions because the other four facilities had HFC emissions of less than 100 tonnes. No facilities reported PFCs or SF_6 emissions for 2004.

3.5 Biomass emissions

CO_2 emissions from the combustion of biomass were a mandatory reporting requirement for 2003 and 2004. In accordance with national and international reporting requirements, theses emissions are not included in any CO_2 emissions total or overall greenhouse gas total, although CH_4 and N_2O emissions from biomass combustion are. Biomass emissions from the combustion of CO_2 are excluded from total emissions to be consistent with the *Intergovernmental Panel on Climate Change guidelines*[vi]. Total reported

biomass emissions for 2004 were five megatonnes. A total of five facilities reported CO_2 emissions from biomass combustion, four forest products facilities and one oil sands facility.

3.6 Optional emissions data

There was a reduction in the reporting of optional data for the 2004 reporting year compared to the 2003 reporting year. This may be due to fewer additional information requirements being specifically mentioned in the *Specified Gas Reporting Standard*[4]. It may also be due to some optional data being relegated to the comments section of the 2004 specified gas report. For the 2003 reporting year, optional data was given an entire section of its own in the Alberta 2003 specified gas report. Optional data including: biological sequestration, indirect emissions, net greenhouse gas emissions, greenhouse gas emissions intensity and equations/calculations/estimation details were all given their own fields for data entry. All of these optional data fields were put into the comment section of the 2004 specified gas report.

No facilities reported biological sequestration for 2004. No facilities reported biological sequestration for 2003 either, even though it had its own field. No facilities reported net greenhouse gas emissions for 2004, down from 25 facilities reporting for 2003. Only six facilities gave further details of how emissions were calculated (equations, specific calculations, models, etc) for 2004, down from the 28 facilities that provided additional information on emission calculations for 2003.

One facility reported greenhouse gas emissions intensity for 2004, down from the 17 that reported for 2003. Several of the facilities that did report emissions intensity data for 2003 were from the pipeline facility type and most of these facilities were voluntary reporters who chose not to report for 2004. This explains some of the drop in facilities reporting emissions intensity data. The one facility that did report emissions intensity for 2004 was a forest products facility. The facility did not report the metric upon which the intensity measurement was based. One facility reported indirect emissions for 2004, down from 25 for 2003. No facilities reported geological injection of CO_2 for 2004, down from three for 2003 when it was a mandatory reporting requirement.

Non-mandatory data including fugitive emissions from venting and flaring and other emissions from on-site transport were given separate fields in the 2004 specified gas report. The number of facilities reporting these was noticeably higher than for optional information relegated to the comments section.

3.7 Emissions by methodology

The *Specified Gas Reporting Standard*[4] required that emissions calculation methods used for determining 2004 greenhouse gas emissions were widely accepted by the industry a facility belongs to; or consistent with the guidelines approved for use by the United Nations Framework Convention on Climate Change (UNFCCC). The four broad

emissions calculations methods used are defined in the *Specified Gas Reporting Standard*[4] as:

> "Monitoring or direct measurement" means a type of emission estimation method using continuous emission monitoring systems (CEMS), predictive emission monitoring (correlations developed between measured emission rates and process parameters) or source testing such as stack sampling.
>
> "Mass balance" means a type of emission estimation method whereby emissions are determined from the difference in the input and output of a unit operation where the accumulation and depletion of a substance are included in the calculations.
>
> "Emission factor" means the representative value that relates the rate or quantity of a specified gas released to the atmosphere with an activity associated with the release of that specified gas.
>
> "Engineering estimates" means the emission estimation method from engineering principles and judgement, using knowledge of the chemical and physical processes involved, the design features of the source, or an understanding of the applicable physical and chemical laws.

Facilities often reported using several emission calculation methods in their greenhouse gas reports. This is due to facilities using different methods for calculating emissions from different gases and from different sources. Emissions factors were the most commonly used method for calculating greenhouse gas emissions for 2004 (see: Figure 11). A total of 97 out of the 99 facilities reporting stated they used emissions factors. Mass balance and engineering estimates were used by roughly half of the facilities (49 and 50 respectively). Monitoring or direct measurement for calculating emissions was used by 42 facilities.

Unlike reporting for 2003, facilities were not required to specify which methods they used for calculating each greenhouse gas and source type emissions. Instead reporters were only required to list any of the methods that were used for measuring CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 from any source type. It therefore cannot be determined with certainty which estimation methods were used for calculating emissions for which gas and for which source type.

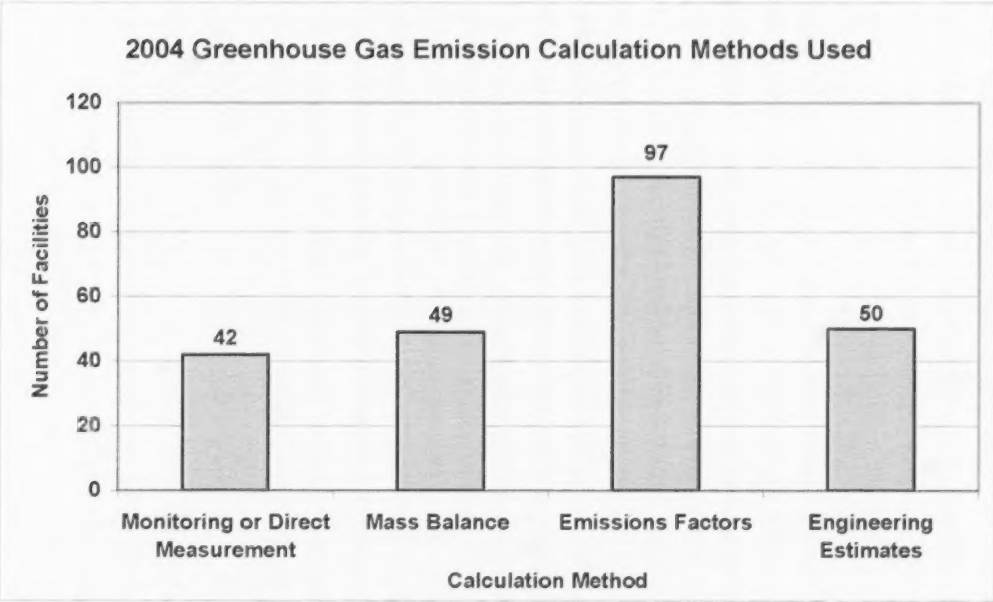


Figure 11: Types of emissions calculation methodologies cited for 2004 reporting.

As mentioned in section 3.6, six facilities did include in their comments more specific information on which methods they used for which gases and source types. The lack of detail for the other facilities has made analysis of changes in emissions (discussed in section 4.0) for facilities that reported for both 2003 and 2004 more difficult. Changing emission calculation methods between reporting years can have significant effects on the numbers that are obtained and can affect how comparable the emissions numbers are. As facilities often used different calculation methods for measuring different gases from different sources, they therefore often listed several calculation methods.

A total of 30 of the 99 facilities reporting used two emission calculation methods (see: Figure 12). Three calculation methods were used by 29 facilities, 23 facilities used one calculation method and 17 facilities used four calculation methods.

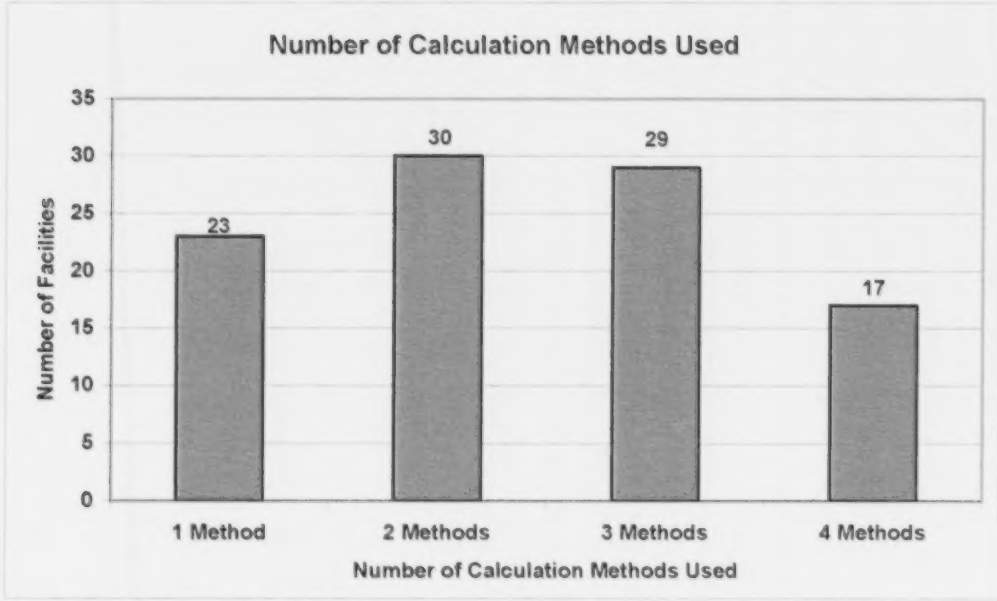


Figure 12: Number of emission calculation methodologies cited for 2004 reporting.

3.8 Reference material cited

Reference materials that were used for calculating greenhouse gas emissions were not a mandatory reporting requirement for 2004. Reference materials used were also no longer given a specific field on the specified gas report; instead this information was shifted to the comments section. As a result, only five facilities reported which reference materials they used compared to 87 facilities for 2003. For those that did give reference material information, multiple documents were listed for many of the facilities. The lack of information collected on the reference materials cited makes it more difficult to compare emissions between facilities, even if they may have used the same emissions calculation methodologies. There was a great deal of variation between the reference documents used by facilities for 2003 reporting and it is likely that this continued for 2004. This variation again makes comparisons of facilities more difficult.

4.0 Comparison of 2003 and 2004 Alberta reported greenhouse gas emissions

4.1 Overall comparison

A total of 97 specified gas reports representing 101 facilities were published in the report: *Alberta Greenhouse Gas Reporting Program for 2003 - Analysis*[v]. One additional facility submitted their 2003 greenhouse gas emissions in September of 2005. The total 2003 greenhouse gas emissions for these 102 facilities was 104 Mt (CO_2-e). There were 99 Alberta facilities that reported greenhouse gas emissions for 2004 for total emissions of 110 Mt (CO_2-e). Every facility type except pipeline saw either an increase or no change in the number of facilities reporting between 2003 and 2004 (see Figure 13). The oil sands facility type did see a decrease of one facility reporting but this was due to two oil sands facilities that reported separately for 2003 reporting together for 2004.

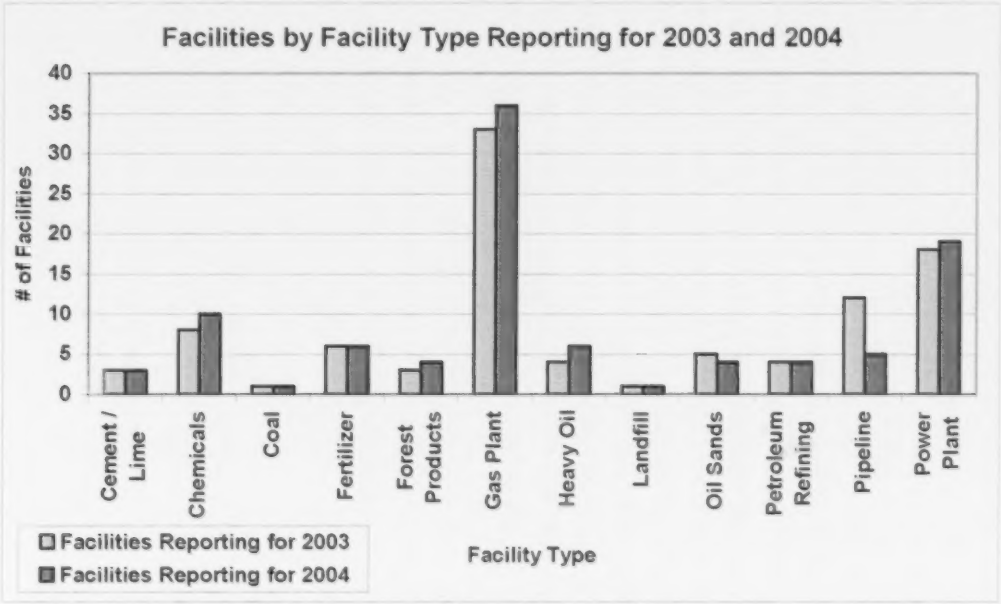


Figure 13: Facilities reporting greenhouse gas emissions for 2003 and 2004.

Based on total reported greenhouse gas emissions, there was a six megatonne difference in total greenhouse gas reported for 2003 and 2004. This difference does not necessarily represent an actual change in emissions from large industrial emitters between 2003 and 2004. This change may be explained as follows:

- There were 15 facilities that reported for 2004 that did not report for 2003 and 12 facilities that reported for 2003 that did not report for 2004. This difference in facilities that reported accounted for about 2.5 Mt of greenhouse gas emissions.

- There were a total of 85 facilities that emitted more than the 100 kt reporting threshold for 2003 compared to 97 facilities for 2004. Therefore, more large facilities reported greenhouse gas emissions for 2004.
- Many facilities may have improved their greenhouse gas calculation processes, leading to more complete reporting from individual facilities.

Reported greenhouse gas emissions for 2003 and 2004 showed very similar percentage breakdowns for gases and source categories. In both years, CO_2 accounted for most of the total greenhouse gas emissions (94 per cent for 2003 and 96 per cent for 2004) with the remainder of the total emissions distributed between CH_4 and N_2O. Looking at greenhouse gas emissions by facility type also showed very similar percentage contributions. Power plant, oil sands and gas plant facilities accounted for over 70 per cent of total greenhouse gas emissions for both years.

The percentage contribution of each gas per facility type and overall for 2004 was nearly identical to that of 2003. The contribution from each source category per facility type and overall for 2004 was also nearly identical to that of 2003. Some variation did occur but was generally quite small and likely the result of different facilities being included in the totals.

4.2 Comparison of facilities reporting both in 2003 and 2004

It is important to know the number of facilities reporting in either year, but for comparing emissions between 2003 and 2004, it is more important to know the number of comparable facilities between those two reporting years. Comparable facilities were matched according to Alberta *Environmental Protection and Enhancement Act*[vii] (EPEA) approval numbers and National Pollutant Release Inventory (NPRI) identification numbers. As some facilities did not have either, other criteria had to be used.

There were 83 comparable facilities that reported for both 2003 and 2004. Table 2 gives the number of facilities showing increases, decreases and no change in emissions by facility type. Of these 83 comparable facilities, 43 (52 per cent) saw increases in their greenhouse gas emissions for 2004 versus their 2003 emissions, 38 (46 per cent) saw decreases and two (two per cent) saw no change (change of < 0.01 per cent). The average change per facility was an increase of two per cent. The average absolute change per facility was 11 per cent. Some of this change from 2003 to 2004 for comparable facilities may be the result of changes in emission calculation methods rather than actual changes in greenhouse gas emissions. However, this observation is difficult to verify because of the lack of detail reported for emission calculation methods.

Table 2: Changes in 2003-2004 emissions by facility type

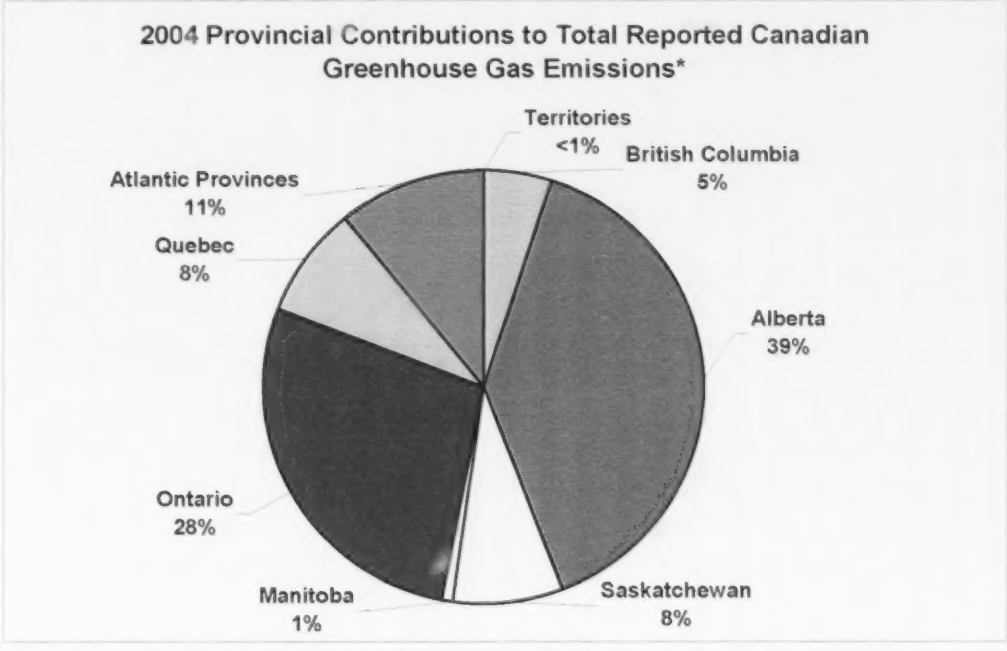
Changes in Reported Emissions by Facility Type				
Facility Type	Comparable Facilities	Facilities Seeing Increases	Facilities Seeing Decreases	Facilities Seeing No Change
Cement/Lime	3	2	1	0
Chemicals	9	4	5	0
Coal-mining	1	1	0	0
Fertilizer	6	4	2	0
Forest Products	3	0	3	0
Gas Plants	31	13	17	1
Heavy Oil	4	3	1	0
Landfill	1	0	0	1
Oil Sands	4	2	2	0
Petroleum Refining	4	3	1	0
Pipeline	2	2	0	0
Power Plant	15	9	6	0

The year-to-year change in emissions for facilities reporting for both years may be the result of non-standardization of calculation methodologies used by facilities. There is a great deal of variability between the accepted emission calculation methods. If a facility changes the methods they use from one year to the next, it can have a significant impact on the calculated emissions. Even the use of different reference materials while still using the same calculation methods can have a large impact. Detailed information on emission calculation methods was not collected for the 2004 reporting year.

Several facilities gave explanations as to why they reported for 2004 but did not report for 2003. Explanations included facilities not exceeding the 100 kt reporting threshold in both years and facilities not being operational for both years.

5.0 Comparison with national data

Total greenhouse gas emissions from large industrial facilities in Canada that reported to the national greenhouse gas reporting system in 2004 were 279 Mt (published in the *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2004*[viii]). Greenhouse gas emissions from large industrial facilities in Alberta accounted for 39 per cent of the national total. Ontario reported the second largest greenhouse gas emissions (28 per cent), while Quebec and Saskatchewan were the next largest contributors with each province responsible for eight per cent of the national total. The remaining provinces and territories each had significantly smaller reported greenhouse gas emissions. Figure 14 shows the percentage contribution of each province/territory to the total 2004 reported Canadian greenhouse gas emissions.



Atlantic Provinces include: Newfoundland & Labrador, New Brunswick, Nova Scotia and Prince Edward Island.
Territories include: Northwest Territories, Yukon and Nunavut.
*Based on reported provincial emissions published in *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2004*[viii].

Figure 14: Reported 2004 provincial/territorial contributions to Canadian greenhouse gas emissions.

6.0 Comparison with the national greenhouse gas inventory

Alberta's reported greenhouse gas emissions for large industry in 2004 accounted for approximately 64 per cent of total industrial emissions and 47 per cent of total greenhouse gas emissions in Alberta. This estimate is based on data from the *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2004*[viii]. Industrial emissions from the inventory were calculated as the sum of emissions from stationary combustion sources (not including construction, commercial & institutional and residential), pipelines, fugitive sources and industrial processes. A comparison of the 2004 reported Alberta greenhouse gas emissions to the 2004 inventory by emission source type is presented in Table 3.

Table 3: Greenhouse gas emission source-types accounted for under the current reporting program.

Emission Source-Type	Emissions (kt CO_2-e)		
	Alberta Emissions from the *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2004*[viii]*	**2004 Alberta Greenhouse Gas Reporting**	**Percent Coverage**
Stationary Combustion*	125,396	92,354	74
Industrial Process	12,700	11,322	89
Fugitive	33,600	3,198	10

*Includes combustion emissions from pipeline facilities and does not include construction, commercial & institutional, and residential.

7.0 Continuous improvement

7.1 Improvements for the third reporting year

All 99 Alberta facilities reported their 2004 greenhouse gas emissions using the national electronic data reporting system. A number of administrative improvements have been made to support reporting 2005 data to the national electronic data reporting system. These include:

- Improving the NAICS selection tool in the EDR system;
- Sending a confirmation email when data submission is successful;
- Replacing the "other" and "fugitive" source categories with more specific ones.
- Pre-populating the 2005 specified gas reports with 2004 administrative information; and
- Adding a save function that allows reporters to save information so they can return to the file and continue entering report information at a later time (up until they formally submit).

7.2 Future improvements

The Alberta specified gas reporting program will continue to evolve in future years to ensure that necessary accurate emissions data is collected while minimizing the burden put on reporters. Future improvements will:

- Establish standard emissions calculation methods for industrial sectors.
- Develop an audit system so that the government can assure the quality of the data submitted.
- Implement systems to allow electronic submission of Statements of Certification and confidentiality requests.
- Coordinate the process for assessing data and information confidentiality between Alberta Environment and Environment Canada.
- Determine intensity metrics and require the reporting of emissions intensity on a carbon dioxide equivalent basis.

Also, the need for more detailed reporting of emissions data from complex facilities such as chemical plants and oil sands facilities will need to be examined. This detailed data may be needed to address the range of activities undertaken or products produced at those types of facilities.

Environment Canada and Alberta Environment are currently discussing several of these potential improvements with industry stakeholders through the National Steering Committee on Reporting (NSCR) and the Stakeholder Advisory Committee on Reporting (SACR). Updated reporting requirements for reporting of 2005 greenhouse gas emissions are available in the *Specified Gas Reporting Standard – March 2006*[ix].

Appendix: Additional emissions data

Table 4: Total 2004 facility-level direct CO_2, CH_4, N_2O and HFC emissions in CO_2-e (*non-confidential data*).

Facility Type	Company	Facility	Total CO_2 Emissions (kt)*	Total CH_4 Emissions (kt)	Total N_2O Emissions (kt)	Total HFC Emissions (kt)	Total CO_2-e (kt)*
Cement/Lime	Graymont Western Canada Inc.	Exshaw	Confidential	Confidential	Confidential	Confidential	Confidential
Cement/Lime	Lafarge Canada Inc	Exshaw Cement Plant	1137	0	0	0	1137
Cement/Lime	Lehigh Inland Cement Limited	Lehigh Inland Cement	784	0	1	0	785
Chemicals	Alberta Envirofuels Inc.	Alberta Envirofuels Inc.	345	1	2	0	348
Chemicals	Cancarb Ltd.	Cancarb Ltd.	127	0	2	0	129
Chemicals	Celanese Canada Inc.	Edmonton Facility	684	1	2	0	687
Chemicals	MEGlobal Canada Inc.	FS1 EOEG	101	3	0	0	104
Chemicals	BP Canada Chemical Company	Joffre LAO Plant	109	0	1	0	110
Chemicals	NOVA Chemicals Corporation	NOVA Chemicals Corporation (Joffre)	3175	4	17	0	3195
Chemicals	MEGlobal Canada Inc.	Prentiss Manufacturing Facility	373	1	0	0	374
Chemicals	Shell Chemicals Canada Ltd	Scotford Chemical Plant	278	0	1	1	280
Chemicals	Air Liquide Canada Inc.	Scotford Complex	361	1	3	0	364
Chemicals	Dow Chemical Canada Inc.	Western Canada Operations	1426	1	2	4	1434
Coal	Transalta Utilities Corporation	Highvale Coal Mine	55	121	1	0	177
Fertilizer	Agrium Inc.	Agrium Redwater Fertilizer Operation	1061	127	20	0	1208
Fertilizer	Canadian Fertilizers Limited	Canadian Fertilizers Limited	1614	0	5	0	1620
Fertilizer	Agrium Inc	Carseland Nitrogen Operations	518	0	2	0	521
Fertilizer	Orica Canada Inc	Carseland Works	0	0	714	0	715

Facility Type	Company	Facility	Total CO_2 Emissions (kt)*	Total CH_4 Emissions (kt)	Total N_2O Emissions (kt)	Total HFC Emissions (kt)	Total CO_2-e (kt)*
Fertilizer	Sherritt International Corporation	Fort Saskatchewan	274	0	1	0	276
Fertilizer	Agrium Inc.	Fort Saskatchewan Nitrogen Operation	607	0	2	0	610
Forest Products	Alberta-Pacific Forest Industries Inc.	Alberta-Pacific Forest Industries Inc. Pulp Mill	82	2	19	0	102
Forest Products	Weyerhaeuser Company Limited	Grande Prairie Operations	90	29	9	0	127
Forest Products	West Fraser Mills Limited	Hinton Pulp	149	1	10	0	160
Forest Products	Daishowa-Marubeni International Ltd.	Peace River Pulp Division	67	7	11	0	85
Gas Plant	Nexen Inc.	Balzac Gas Processing Plant	264	56	3	0	323
Gas Plant	Imperial Oil Resources	Bonnie Glen Gas Plant	324	32	5	0	360
Gas Plant	Petro-Canada	Brazeau Gas Plant	133	14	2	0	149
Gas Plant	Keyera Energy	Brazeau GP	89	9	4	0	102
Gas Plant	EnCana Corporation	Caribou North Compressor Station	97	24	12	0	133
Gas Plant	Bonavista Petroleum Ltd.	Carstairs - Crossfield Gas Plant	109	1	0	0	110
Gas Plant	Inter Pipeline Extraction Ltd.	Cochrane Extraction Plant	387	6	4	0	398
Gas Plant	PrimeWest Energy Inc.	East Crossfield Gas Plant	181	4	2	0	186
Gas Plant	Talisman Energy Inc.	Edson Gas Plant	258	8	4	0	271
Gas Plant	Burlington Resources Canada Ltd.	Elmworth Sweet GP	142	10	4	0	156
Gas Plant	BP Canada Energy Company	Empress Gas Plant	67	17	18	0	102
Gas Plant	ConocoPhillips Canada	Empress Straddle Gas Plant	362	4	4	0	370

Facility Type	Company	Facility	Total CO_2 Emissions (kt)*	Total CH_4 Emissions (kt)	Total N_2O Emissions (kt)	Total HFC Emissions (kt)	Total CO_2-e (kt)*
Gas Plant	BP Canada Energy Company	Fort Saskatchewan Storage & Fractionation	107	0	1	0	108
Gas Plant	Petro-Canada	Hanlan Robb Gas Plant	573	26	5	0	605
Gas Plant	SOLEX Gas Processing Corp.	Harmattan Gas Processing Plant	262	21	3	0	286
Gas Plant	Anadarko Canada Corporation	Hays Gas Plant	97	11	1	0	110
Gas Plant	Pengrowth Corporation	Judy Creek Gas Conservation Plant	126	23	5	0	153
Gas Plant	Pengrowth Corporation	Judy Creek Production Complex	78	11	4	0	92
Gas Plant	Canadian Natural Resources Limited	Karr Gas Plant/Gathering System	105	11	1	0	117
Gas Plant	Central Alberta Midstream	Kaybob Amalgamated Facility	221	13	7	0	242
Gas Plant	Central Midstream (ccr1) Company	Kaybob South #3 Gas Plant	410	8	2	0	419
Gas Plant	Duke Energy Field Services Canada	Nevis Gas Plant	127	12	7	0	146
Gas Plant	Anadarko Canada Corporation	Progress Gas Plant	98	7	2	0	107
Gas Plant	Imperial Oil Resources	Quirk Creek Gas Plant	115	11	1	0	127
Gas Plant	Husky Oil Operations Limited	Ram River	863	5	2	0	870
Gas Plant	BP Canada Energy Company	Ricinus Sweet Gas Plant	96	10	5	0	111
Gas Plant	Keyera Energy	Rimbey Gas Plant	240	6	3	0	250
Gas Plant	Shell Canada Limited	Shell Burnt Timber Gas Plant	203	60	1	0	263
Gas Plant	Shell Canada Limited	Shell Caroline Complex	689	92	5	0	786
Gas Plant	Shell Canada Limited	Shell Jumping Pound Gas Plant	259	77	2	0	339

Facility Type	Company	Facility	Total CO_2 Emissions (kt)*	Total CH_4 Emissions (kt)	Total N_2O Emissions (kt)	Total HFC Emissions (kt)	Total CO_2-e (kt)*
Gas Plant	Keyera Energy	Strachan GP	268	8	3	0	280
Gas Plant	Devon Canada Corporation	Wapiti Gas Plant	110	20	1	0	131
Gas Plant	Shell Canada Limited	Waterton Complex	505	92	6	0	603
Gas Plant	BP Canada Energy Co	West Whitecourt	128	11	3	0	142
Gas Plant	Petro-Canada	Wildcat Hills Gas Plant	177	9	2	0	187
Gas Plant	Apache Canada Ltd.	Zama Gas Plant: 1, 2, 3	83	45	4	0	132
Heavy Oil	EnCana Corporation	Christina Lake SAGD Bitumen Battery	107	1	0	0	108
Heavy Oil	Imperial Oil Resources	Cold Lake	4149	8	18	0	4175
Heavy Oil	EnCana Corporation	Foster Creek SAGD Bitumen Battery	315	0	1	0	316
Heavy Oil	Japan Canada Oil Sands Limited	Hangingstone SAGD Demonstration Facility	164	1	1	0	165
Heavy Oil	Shell Canada Limited	Peace River Complex	325	37	5	0	367
Heavy Oil	Canadian Natural Resources Limited	Wolf Lake/Primrose Thermal Operation	1829	55	12	0	1896
Landfill	City of Calgary	East Calgary Landfill	0	122	0	0	122
Oil Sands	Petro-Canada	MacKay River, In-Situ Oil Sands Plant	183	45	3	0	231
Oil Sands	Syncrude Canada Ltd.	Mildred Lake and Aurora North Plant Sites	9551	716	101	0	10367
Oil Sands	Albian Sands Energy Inc.	Muskeg River Mine	235	1	19	0	255
Oil Sands	Suncor Energy Inc. Oil Sands	Suncor Energy Inc. Oil Sands	8120	393	86	0	8599
Petroleum Refining	Petro-Canada	Edmonton Refinery	1388	5	6	0	1399
Petroleum Refining	Shell Canada Limited	Scotford Upgrader and Upgrader Cogeneration	2004	8	4	0	2016
Petroleum Refining	Shell Canada Products	Shell Scotford Refinery	1080	0	2	0	1083

Facility Type	Company	Facility	Total CO_2 Emissions (kt)*	Total CH_4 Emissions (kt)	Total N_2O Emissions (kt)	Total HFC Emissions (kt)	Total CO_2-e (kt)*
Petroleum Refining	Imperial Oil Limited	Strathcona Refinery	1490	1	9	0	1500
Pipeline	Foothills Pipe Lines Ltd.	Acme Compressor Station # 363	276	1	4	0	281
Pipeline	Alliance Pipeline Ltd.	Alberta Pipeline System	514	37	4	0	555
Pipeline	ATCO Gas and Pipelines Ltd.	ATCO Pipelines	81	134	2	0	216
Pipeline	Nova Gas Transmission Ltd.	Cardinal Lake Compressor Station	1733	420	26	0	2180
Pipeline	ATCO Gas and Pipelines Ltd.	Distribution system and Carbon Plant	32	235	2	0	269
Power Plant	Alberta Power (2000) Ltd.	Battle River Generating Station	5155	1	29	0	5186
Power Plant	Calpine Canada Power Ltd	Calpine Calgary Energy Centre	347	1	3	0	351
Power Plant	TransCanada Energy Ltd.	Carseland Power Plant	323	1	4	0	328
Power Plant	EnCana Corporation	Cavalier Power Plant	137	0	1	0	138
Power Plant	City Of Medicine Hat	City Of Medicine Hat, Electric Utility - Generation	261	4	2	0	266
Power Plant	EPCOR Generation Inc.	Clover Bar Thermal Generating Station	105	1	1	0	106
Power Plant	TransAlta Cogeneration LP	Fort Saskatchewan Generating Plant	359	1	3	0	362
Power Plant	EnCana Corporation	Foster Creek Cogeneration Facility	459	1	5	0	466
Power Plant	EPCOR Generation Inc.	Genesee Thermal Generating Station	6733	1	58	0	6792
Power Plant	Milner Power Inc.	H.R. Milner Generating Station	959	0	5	0	965

Facility Type	Company	Facility	Total CO_2 Emissions (kt)*	Total CH_4 Emissions (kt)	Total N_2O Emissions (kt)	Total HFC Emissions (kt)	Total CO_2-e (kt)*
Power Plant	Transalta Utilities Corporation	Keephills Generating Plant	5990	1	41	0	6032
Power Plant	TransCanada Energy Ltd.	Mackay River Power Plant, Alberta	413	1	6	0	419
Power Plant	ATCO Power Canada Ltd.	Muskeg River Cogeneration Power Plant	1145	1	6	0	1153
Power Plant	ATCO Power Alberta Ltd.	Rainbow Lake Cogeneration Power Plant (Units 4-5)	198	0	2	0	200
Power Plant	Alberta Power (2000) Ltd.	Rainbow Lake Generating Station (Units 1-3)	131	0	1	0	132
Power Plant	TransCanada Energy Ltd.	Redwater Cogeneration Facility, Alberta	191	2	2	0	195
Power Plant	Alberta Power (2000) Ltd.	Sheerness Generating Station	6601	2	37	0	6640
Power Plant	Transalta Utilities Corporation	Sundance Generating Plant	16344	4	116	0	16464
Power Plant	TransAlta Utilities Corporation	Wabamun Generating Plant	3166	1	24	0	3190

*Excludes CO_2 biomass emissions.

References

[i] *Albertans and Climate Change: Taking Action*. Alberta Environment, Government of Alberta. October, 2002. http://www3.gov.ab.ca/env/climate/docs/takingaction.pdf.

[ii] *Specified Gas Reporting Standard*. Alberta Environment, Government of Alberta. March 2005.

[iii] *Specified Gas Reporting Regulation*, Alberta Regulation 251/2004, Alberta Environment, Government of Alberta. http://www.qp.gov.ab.ca/documents/Regs/2004_251.cfm?frm_isbn=0779733134.

[iv] *Climate Change and Emissions Management Act*. Alberta Environment, Government of Alberta February 2005. http://www.qp.gov.ab.ca/documents/Acts/C16P7.cfm?frm_isbn=0779733363.

[v] *Alberta Greenhouse Gas Reporting Program for 2003 – Analysis*. Alberta Environment, Government of Alberta, September 2005. http://www3.gov.ab.ca/env/air/pubs/GHGanalysis03data1.pdf.

[vi] *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. Intergovernmental Panel on Climate Change (IPCC)/Organization for Economic Cooperation and Development (OECD)/International Energy Agency (IEA), 1997. http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm .

[vii] *Environmental Protection and Enhancement Act*. Alberta Environment, Government of Alberta. September 1, 1993. http://www3.gov.ab.ca/env/protenf/approvals/factsheets/enhanact.html.

[viii] National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990–2004. Greenhouse Gas Division, Environment Canada, May 2006. http://www.ec.gc.ca/pdb/ghg/ghg_home_e.cfm.

[ix] *Specified Gas Reporting Standard – March 2006*. Alberta Environment, Government of Alberta. March 2006. http://www3.gov.ab.ca/env/air/pubs/ghg_specified_gas_reporting_standard.pdf.